Science Based Development of a DI&M Program

Methane to Markets Partnership Technology Transfer Workshop

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Regulatory Context

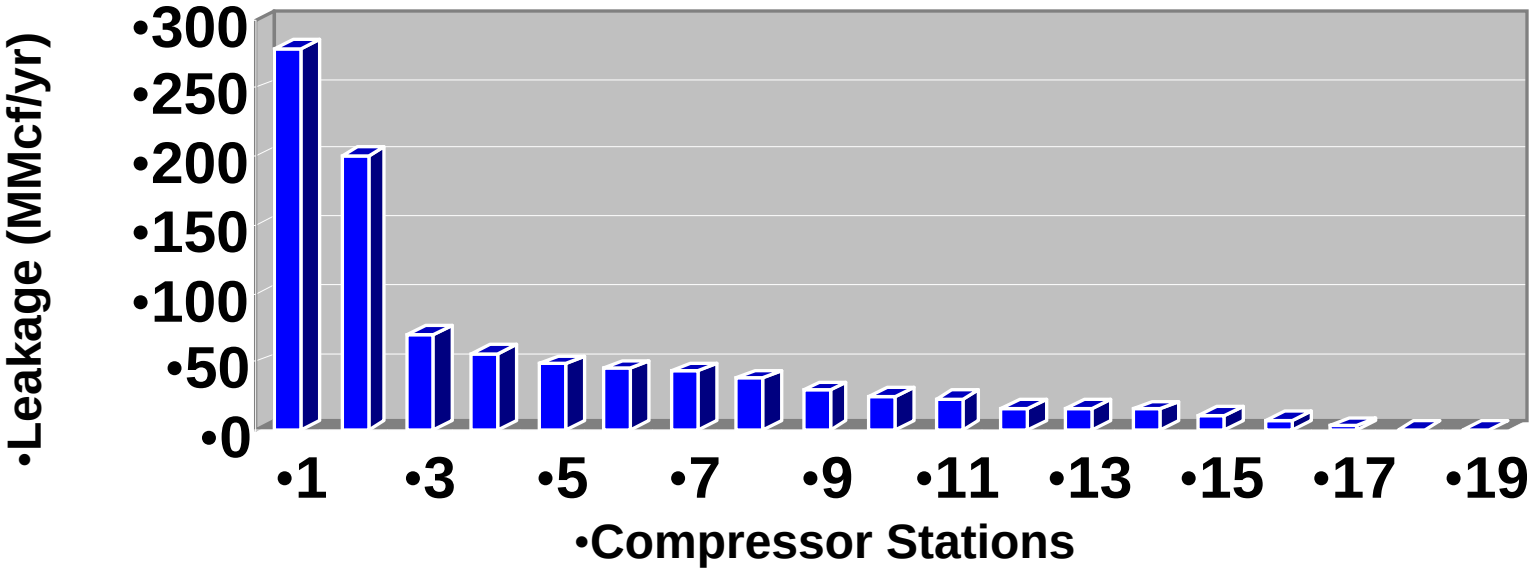
- Fugitive emissions management is a regulatory requirement for the upstream oil and natural gas industry in Alberta (ERCB Directive 60):
  - Operators must develop and implement a program to detect and repair leaks.
    - These programs must meet or exceed the CAPP *Best Management Practice for Fugitive Emissions Management*.
  - Operators must use pressurized tank trucks or trucks with suitable and functional emission controls when transporting sour fluids from upstream petroleum industry facilities.
- ERCB Response:
  - Purchased IR camera and has established its own inspection team.
  - Checks to see that companies are implementing their FEM plans.
  - Plans to review industry's response to the BMP at the end of 2009.

Leak Characteristics

- Contribute significantly to total CH_4 emissions at natural gas facilities.
- Only a few percent of the components actually leak.
- Most of the leakage is usually from just a few big leakers.
- Different types of components have different leak potentials and wear out at different rates.
- Components in sour or odorized service tend to leak less than those in sweet or unodorized service.

Fugitive Emissions

- Distribution of opportunities is skewed.
- Few sources are responsible for majority of emissions-focus efforts on these sources first.



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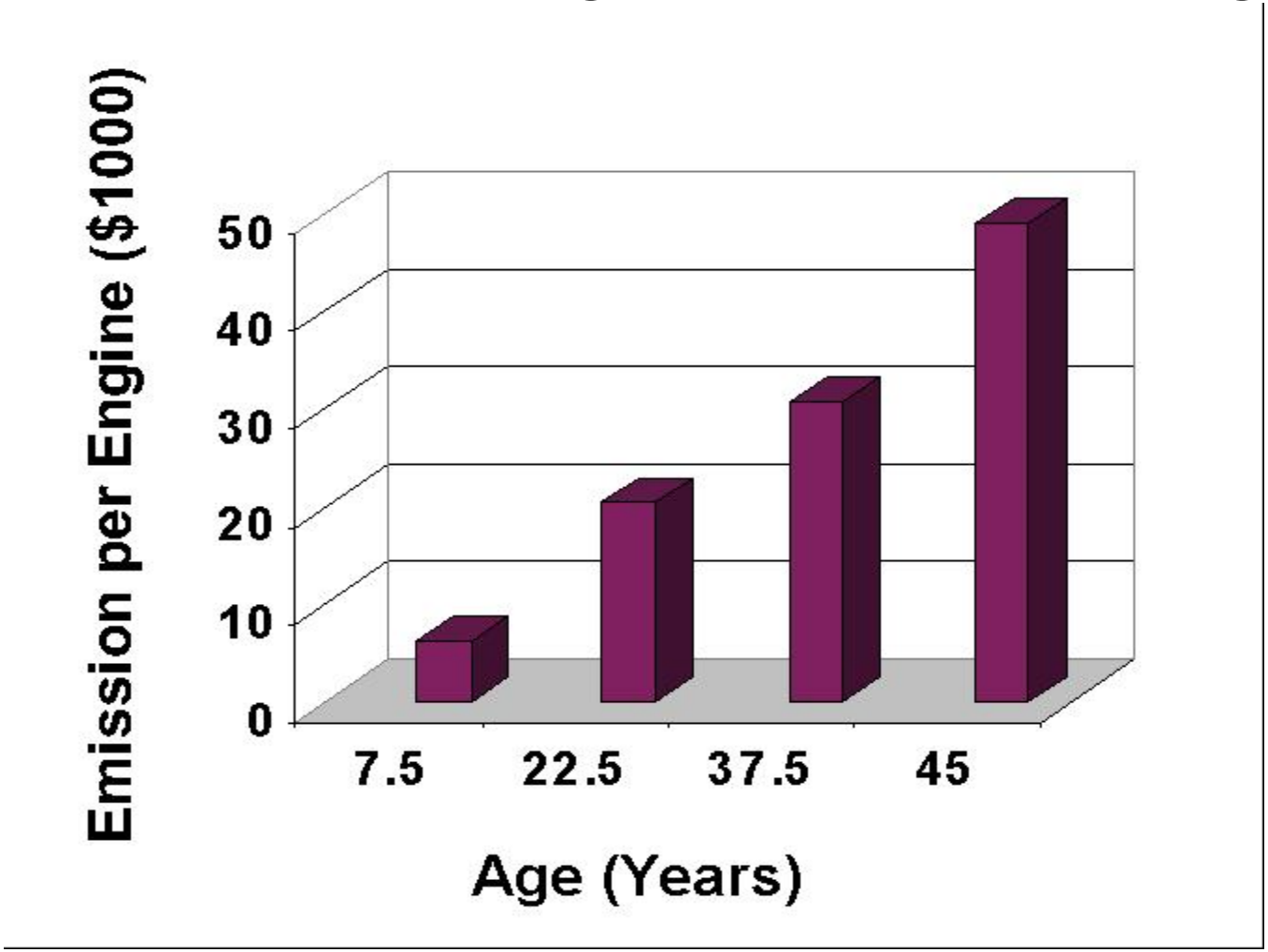
Opportunities are Greatest at Older Facilities: Average Emissions vs Age



Reasons for Big Leaks

- Flaws, improper installation, damage, and progressive deterioration.
- Severe/demanding applications coupled with high cost or difficulty of repairs.
- Lack of leak checks after maintenance activities.
- Unnoticed leaks because they occur in difficult-to-access, low-traffic, crowded or noisy areas.
- Lack of measurement data to build a business case.

Average Leak Trends at 9 Gas Plants and 9 Upstream Compressor Stations

Facility Type	Components Surveyed	Leak Frequency (%)	Emissions From All Leaking Sources			Contribution to THC Emissions	
			THC ($10^3 m^3$/ y)	CH4 (tonnes/ y)	Value ($/y)	(%)	(%)
Gas Plants	16 547	2.5	1 680	924	488 206	54	43
Compressor Stations	2 478	1.5	146	85	43 992	83	64

What is Normal Practice?

- Perform a leak check (using a bubble test or hand held gas sensor) on equipment components when first installed and after inspection and maintenance.
- Thereafter, leaks are detected by:
  - Area or building monitors.
  - Personal monitors.
  - Olfactory, audible or visual indicators.
- Leaks are fixed if it is easy to do or they pose a safety concern.
- Unmanned facilities get less attention than manned facilities.
- Priority following a facility turnaround is to get it back online rather than ensure all affected components have been leak checked.

What is Directed Inspection & Maintenance or DI&M?

- It is a practicable ongoing approach to achieving significant cost-effective reductions in fugitive equipment leaks:
  - Find the big leaks in an efficient manner:
    - Focus efforts on the most likely sources of big leaks with coarse or less frequent screening of other components.
  - Only repair components that are cost-effective to repair or pose a safety or environmental concern.
  - Minimize the potential for big leaks and provide early detection and repair of these when they occur.

What is DI&M?

- Implement repairs as soon as possible, or at the next facility turnaround if a major shutdown is required.
- Check for leaks after maintenance or adjustment of equipment.
- Consider leakage directly to the atmosphere as well as into vents, flares and blowdown systems.

What are the Benefits?

- Practicable, less expensive alternative to LDAR.
- Resource conservation.
- Increased revenue.
- Cost-effective
- Improved system reliability.
  - Reduced downtime.
  - Potentially reduced maintenance costs through early detection of problems.
- Safer work place.
- Improved environmental performance.
- Best-in-Class recognition.

Where Should Efforts be Focused?

Sample Leak Statistics for Gas Transmission Facilities						
Source	**Number of Sources**	**Leak Frequency**	**Average Emissions (kg/h/source)**	**Percent of Component Population**	**Contribution to Total Emissions (%)**	**Relative Leak Potential**
Pressurized Station or Unit Blowdown System	219	59.8	3.41E+00	0.131	53.116	7616
Compressor Seal – Centrifugal	103	64.1	1.27E+00	0.062	9.310	2838
Compressor Seal – Reciprocating	167	40.1	1.07E+00	0.100	12.764	2400
Pressure Relief Valve	612	31.2	1.62E-01	0.366	7.062	362
Open-Ended Line	928	58.1	9.18E-02	0.555	6.070	205
Orifice Meter	185	22.7	4.86E-02	0.111	0.641	109
Control Valve	782	9	1.65E-02	0.468	0.919	37
Pressure Regulator	816	7	7.95E-03	0.488	0.462	18
Valve	17029	2.8	4.13E-03	10.190	5.011	9
Connector	145829	0.9	4.47E-04	87.264	4.644	1
Other Flow Meter	443	1.8	9.94E-06	0.265	0.000	0.02

Suggested Monitoring Frequencies

Component Specific Suggested Leak Monitoring Frequencies				
Source Category	**Type of Component**	**Service**	**Application**	**Frequency**
Process Equipment	Connectors and Covers	All		Immediately after any adjustments and once every 5 years thereafter.
	Control Valves	Gas/Vapour/LPG		Annually.
	Block Valves – Rising Stem	Gas/Vapour/LPG	All	Annually.
	Block Valves – Quarter Turn	Gas/Vapour/LPG	All	Once every 5 years.
	Compressor Seals	All	All	Quarterly.
	Pump Seals	All	All	Quarterly.
	Pressure Relief Valves	All	All	Annually.
	Open-ended Lines	All	All	Annually.
	Emergency Vent and Blowdown Systems[1]	All	All	Quarterly.
Vapour Collection Systems	Tank Hatches	All	All	Quarterly.
	Pressure-Vacuum Safety Valves	All	All	Quarterly.

Implementing a DI&M Program

- Establish emissions baseline.
- Target a <2% leak frequency in each component category.
- Establish a facility-specific DI&M plan to include monitoring performance over time.
- Encourage facility personnel to self monitor with particular emphasis on the most likely sources of big leaks.

Implementing a DI&M Program

- Achieve optimum balance between manual, instrumented and contracted solutions.
  - Consider the use of IR cameras and Hi-Flow sampler.
- Prioritize and implement solutions.
- Conduct confirmatory field measurement.
- Achieve real cost-effective emission reductions.
- Document efforts and experiences.

Key Elements of a DI&M Program

- Periodic Comprehensive Leak Surveys.
  - Once every 5 years.
- Targeted quarterly and annual monitoring.
  - Compressor and pump seals.
  - Pressure-vacuum valves on blanketed tanks.
  - Blowdown systems.
  - PRVs, control valves and rising-stem block valves.

Key Elements of a DI&M Program

- Consider permanent instrumented or easy-to-access monitoring systems.
  - For difficult-to-access sources with high leak potentials.
- Leak checks following maintenance or adjustments.
  - Establish as standard practice and be able to document that this is being done.

Wrap up

- Questions?
- Additional Information
  - http://www.capp.ca/getdoc.aspx?DocId=116116&DT=PDF
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